

Determination of Supply Air Relative Humidity to Control Internal Latent Gains

Internal Latent Gains Taken from CIBSE Guide A Table 6.2:

Offices General / City Centre based on Moderate Office Work Latent Heat Gain: 55W / Person

The primary equation used is:-

$$gs = groom - (\Theta L / X * hfg)$$

Where:

gs = Moisture Content Supply Air (kg/kg)

groom = Moisture Content Room (kg/kg)

ΘL = Total Spatial Latent Gains (kW)

X = Fresh Air Supply Volume (kg/s) = Fresh Air Supply Volume (m³/s) * 1.177 (kg/m³).

hfg = Latent Heat of Evaporation (approx 2450 kJ/kg)

Worked Example:

Determine the required AHU air supply humidity for an active chilled beam system based on the following design parameters:

Open Plan Room Size: 15 x 5m (75m²) x 3.0m high.

Indoor Average Room Temperature: 24°C

Maximum Dew Point: 14°C

Outdoor Air Design Condition: 20.0°C WB

Occupancy: 30 people

Infiltration: 0.15 ACH

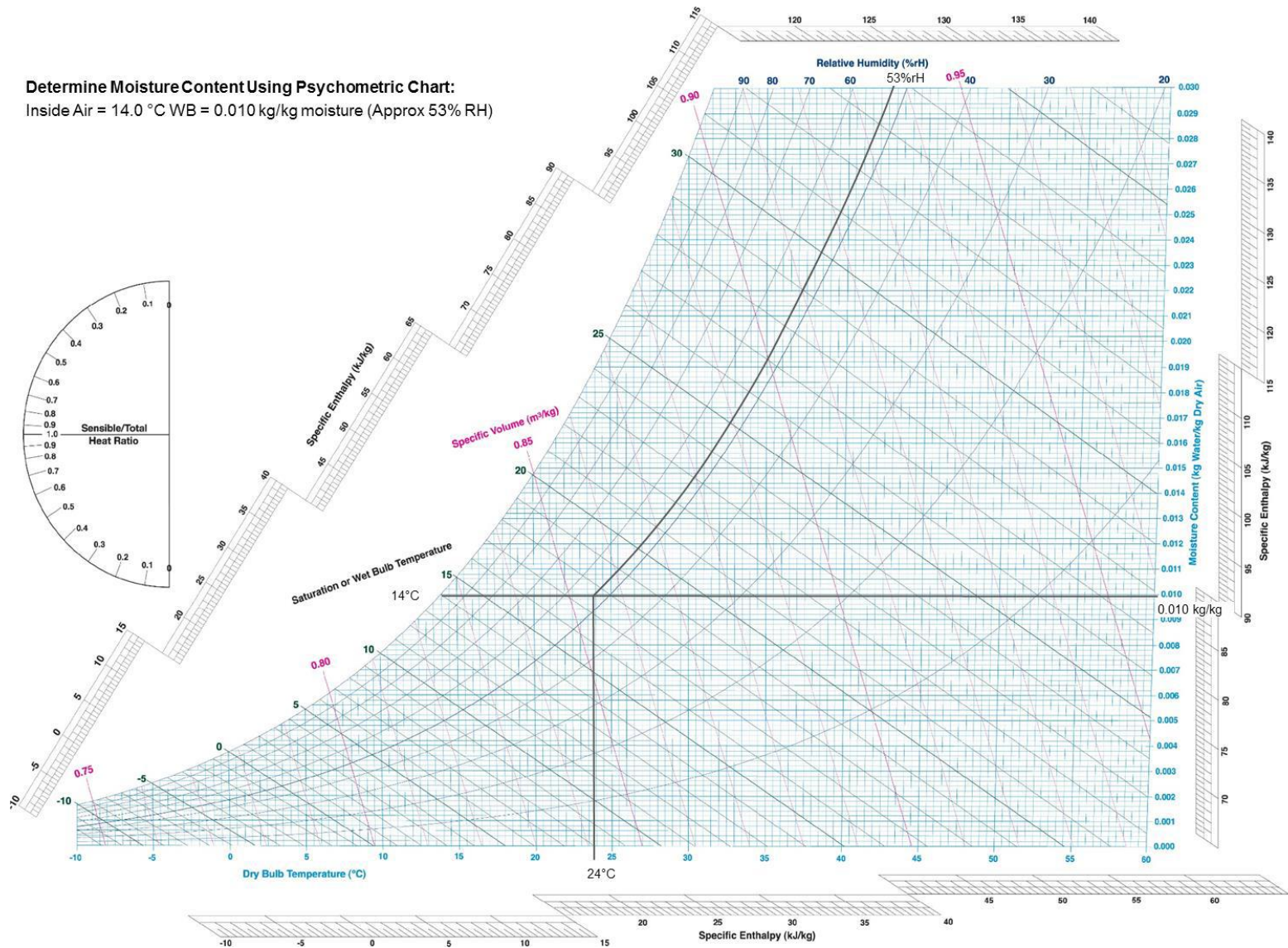
Air Supply Volume: 8 l/s/person

Air Supply Temperature: 16°C after re-heat.

1. Determine internal moisture content using psychrometric chart:

Determine Moisture Content Using Psychrometric Chart:

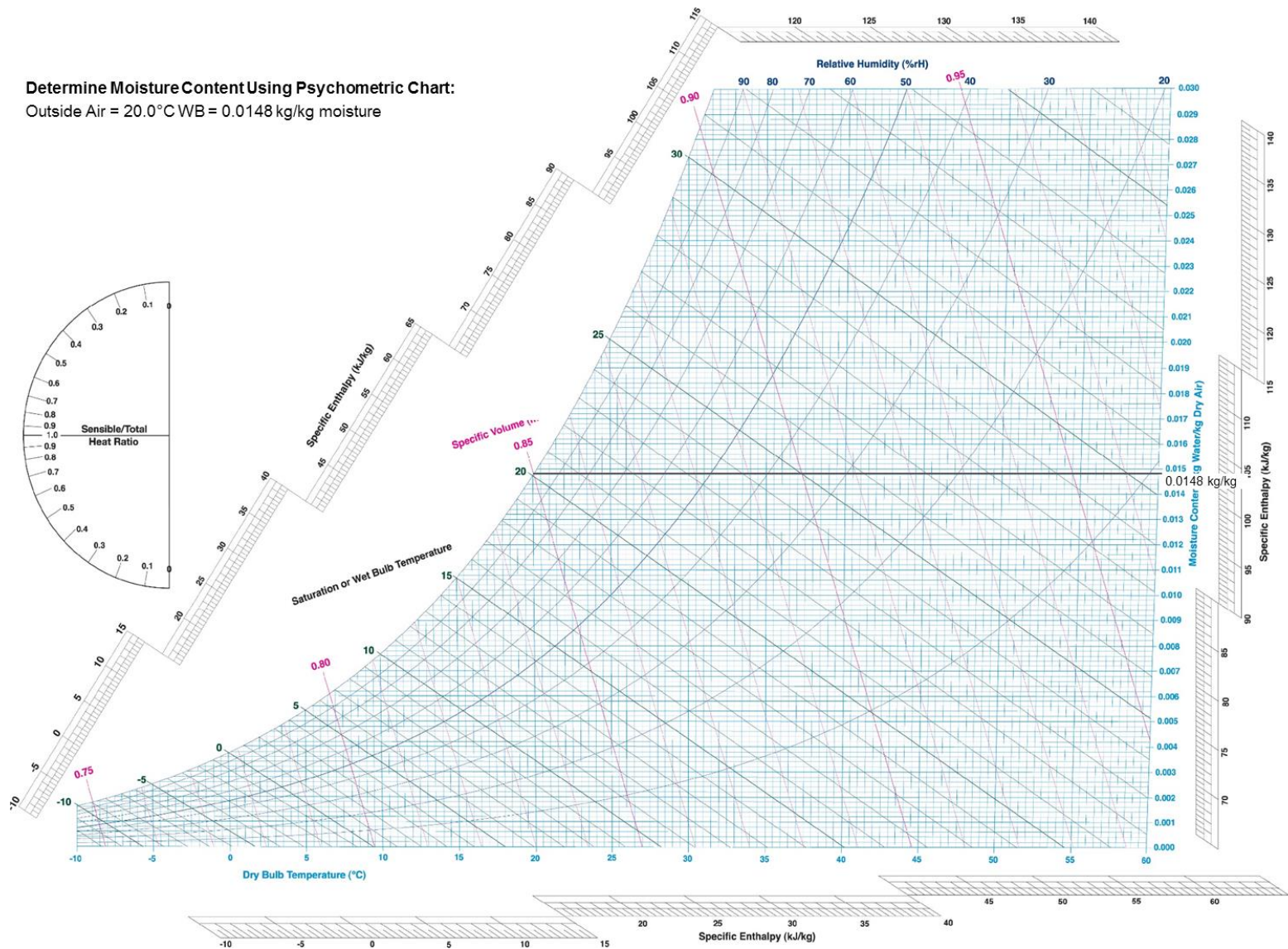
Inside Air = 14.0 °C WB = 0.010 kg/kg moisture (Approx 53% RH)



2. Determine outside moisture content using psychrometric chart:

Determine Moisture Content Using Psychrometric Chart:

Outside Air = 20.0°C WB = 0.0148 kg/kg moisture



3. Determine Infiltration Gain:

$$\begin{aligned} \text{Infiltration (Xi) @ 0.15 ACH} &= 0.15 \times 15\text{m} \times 5\text{m} \times 3\text{m} = 33.75 \text{ m}^3/\text{hr} \\ &= 0.00938 \text{ m}^3/\text{s} \\ &= 0.00938 \times 1.177 = \mathbf{0.01103 \text{ kg/s}} \end{aligned}$$

Using: $\Theta_{li} = (\text{g}_{\text{introduced}} - \text{g}_{\text{room}}) \times X \times \text{hfg}$

$$\begin{aligned} &= (0.0148 - 0.010) \times 0.01103 \times 2450 \\ &= \mathbf{0.130 \text{ kW}} \end{aligned}$$

4. Determine Spatial Latent Gains:

Occupancy Latent = (Latent Heat Gain per Person * Occupancy)

Occupancy Latent = (55 * 30) = 1650 W = 1.65kW

Total Spatial Latent Gains (Θ_L) = 0.130 + 1.65 = **1.78 kW**

Total Fresh Air Supply = 30 x 8 = 240l/s = 0.24 m³/s
= 0.24 * 1.177 = **0.2825 kg/s**

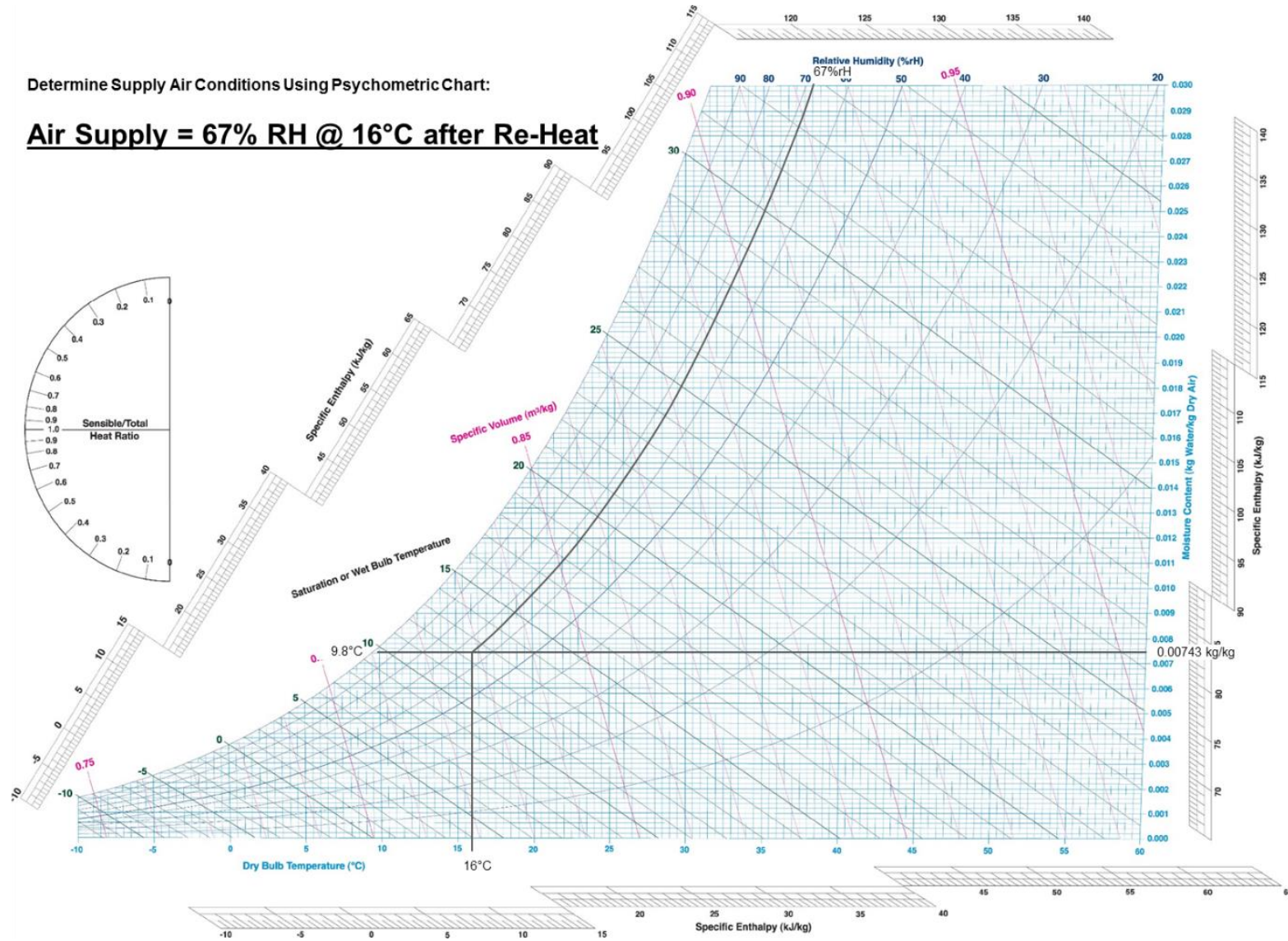
Using: $\text{gs} = \text{g}_{\text{room}} - (\Theta_L / X \times \text{hfg})$

$$\begin{aligned} \text{gs} &= 0.010 - (1.78 / 0.2825 \times 2450) \\ \text{gs} &= 0.010 - 0.00257 \\ \mathbf{\text{gs} &= 0.00743 \text{ kg/kg}} \end{aligned}$$

5. Determine required supply air conditions using psychrometric chart:

Determine Supply Air Conditions Using Psychrometric Chart:

Air Supply = 67% RH @ 16°C after Re-Heat



Result: Fresh air supply to be dehumidified to 9.8°C WB (approx. 67% RH after reheat to 16.0°C.